INITIAL CAPABILITIES DOCUMENT (ICD)

FOR

Live Training Transformation – Family of Training Systems

(LT2-FTS)

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for
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1.0 Army/Joint Functional Area.

Today, the Army must meet the challenge of a wider range of threats and prepare the force to incorporate newer, more robust technologies that are adaptable to a more complex group of operating environments. As we transform to a more agile, versatile, lethal, sustainable, and survivable Army, the competence and confidence needed to win decisively on the battlefield is born in part out of the virtual and constructive training environments. However, it is the live training environment (LTE) that provides the most demanding crucible of experience that enhances Soldiers, leader, and unit warfighting capabilities. Live, integrated, interoperable training systems exist across various tactical tasks but are categorized primarily in the Army's Command and Control (C2) Battlefield Operating System (BOS); specifically under Army Universal Task List (AUTL), Army Tactical Task (ART) 7.7.3, Train Subordinates and Units. Army Tactical Task (ART) regarding training are most noticeably linked with the following tasks from the Universal Joint Tasks List (UJTL): Strategic National (SN) Task 3.1.4, Coordinate Joint/Multinational Training Events; 6.3.2, Conduct Specified Training; 6.5, Provide for Combat Identification; 6.6.2, Expand Training Base; 7.4, Educate and Train the Force; Strategic Theater(ST) Tasks 4.2.4, Establish and Coordinate Training of Joint and Combined Forces and Conditions/Standards; 7.2.4, Assess Training and Education Effectiveness; and Operational (OP) Tasks 3.1.6.1, Assess Battle Damage Effects on Operational Targets; 3.1.6.2, Assess Munitions Effects on Operational Targets; 5.2, Assess the Operational Situation.

1.1 Functional Area Concept. Training affects Soldiers and leaders throughout every functional area and across the full spectrum of military operations. The need for the LTE capabilities to keep pace with the transforming Army and to become more interoperable within the Joint community is recognized throughout current draft and approved concept documents. To provide Soldiers with the level of training and exposure required to conduct combat operations, live training

technologies must be available and integrated to replicate realistic contemporary operational environments (COE) at combat training centers (CTCs) and homestation. Additionally, the Future Force concept requires instrumented and modernized homestation training areas and CTCs that support the Current Force and maximizes embedded training capabilities. Extracts from selected and relevant documents are cited below:

1.1.1 "Conduct large-scale, simultaneous and distributed, multi-dimensional combat operations (including unconventional and forcible-entry operations) regardless of existing target area infrastructure and environmental conditions; isolate the battlespace from unwanted influences; strike with great discrimination; move with great speed; and identify and eliminate or neutralize an opponent's asymmetric advantages, while securing and strengthening friendly asymmetric advantages."[1]

1.1.2 "The ability to integrate stability operations training with combat training"[2] (Command and Control).

1.1.3 "The ability to train operational headquarters to execute stability and major combat operations simultaneously"[3] (Force Application).

1.1.4 "The ability to evaluate data and information using domain expertise and proven technologies to determine significant entities, trends and relationships, then disseminate relevant and coherent analysis to all levels of the organization, from national level policy makers to operational commanders to tactical leaders in the field"[4] (Battlespace Awareness).

1.1.5 "Joint National Training Capability will drive the transformation of our military forces by creating, storing, imparting, and applying knowledge in improved ways to units and staffs. It will also prepare forces by providing units and command staffs with an integrated live, virtual, and constructive training environment with appropriate joint context

[1] Major Combat Operations Joint Operating Concept, 16 December 2003
[2] Stability Operations, Joint Operating Concept, 16 December 2003
[3] Ibid
[4] Ibid

that allows accurate, timely, and relevant training and mission rehearsal in support of specific operational needs."[5]

1.1.6 "Vertically and horizontally integrate system of systems at homestation, institutions and while deployed. Provides an embedded training architecture for CTC quality after-action reviews (AARs) that captures what happened, why and how to fix."[6]. Rotations at the Combat Training Centers (CTCs), now connected to the Joint National Training Capability (JNTC) for greater degree of Joint Interagency Multinational (JIM) participation, remain The Army's capstone training event. Training capabilities are "embedded" into every new Future force system to allow Soldiers and leaders to train realistically, to build functional combined arms teams, and learn from their mistakes using virtual and constructive tools, as well as instrumentation.

1.1.7 "Training support capabilities must be available worldwide and around-the-clock to provide Soldiers, leaders, and trainers with flexible, structured training support products, exercises, and mission rehearsal capabilities. Essential capabilities include the ability to provide synthetic environment battlefields that can be integrated with live training and the ability to use automated training management tools to operate in the OP environment."[7] A robust Command, Control, Communications, Computers, and Intelligence (C4I) backbone and installation training support infrastructure provides the connectivity for live, virtual, and constructive training and allows units to train-alert-deploy. Training systems will operate with both unclassified and classified families of systems.

1.1.8 The Army is fielding the first Units of Action (UA) and two Units of Employment (UE) in a holistic fashion that integrates doctrine, organizations, training, materiel, leadership, personnel and facilities (DOTMLPF).[8] New weapons, sensors, digital command and control systems, and corresponding Training Aids, Simulators, and Simulations (TADSS) are integrated, fielded, and upgraded as a unit set. The facilities to operate, maintain, and train with the equipment are in place as the set is delivered to the unit.[9]

[5] 2004 DOD Training Transformation Implementation Plan, 9 June 2004
[6] TRADOC Pamphlet 525-3-90, Unit of Action O&O, 30 June 2003
[7] Ibid
[8] Ibid
[9] The Army Campaign Plan, 12 April 2004

1.1.9 "Be able to link training constructs for battalion and brigade with training for individual Soldiers and small unit collective skills to conduct multi-echelon training that can be distributed to live, virtual, and constructive participants. Can train 3-6 battalions with pooled UE type assets, institutional, Joint participants, and CTC at home or remotes stations."[10]

1.1.10 "Technologies such as networked communications and directed energy weapons have increased training facility requirements. Live-virtual-constructive connectivity provides the flexibility to tailor installation training capabilities across the full spectrum of mission requirements."[11] Training ranges will be modernized, sustained, and protected from encroachment, and instrumentation will be improved. To support and maintain lethality, the UA and UE, regardless of homestation, can train with any other UA/UE or JIM force globally. Installations have implemented the Army Sustainable Range Program (SRP) to effectively manage and sustain Army training land and ranges in order to protect training resources and mitigate training-related impact on the environment.

1.2 Summary. Future concepts dictate the direction in which the Army must transform its training, installations, and business practices in order to meet the objectives of Joint integration and interoperability and the idea of "one team one fight."[12] Achieving Current and Future Force operational capabilities; network enabled battle command, operational maneuver from strategic distances, entry and shaping operations, simultaneous, decisive, and distributed operations all require the transformation of LTE capabilities. This transformation will enable the training environment to better replicate the operational environment. A robust and adaptable LTE capability is essential to keep pace with a transforming force. This LTE objective must be initiated now to reach full implementation by 2015 and to support the Current and Future Force train as they fight concept.

2.0 Required Capability.

2.1 Overview. Live training systems must replicate, as closely as possible, the capabilities inherent in the operational environment to provide realism and support continuity from the training arena to real world operations.

[10] TRADOC Pamphlet 525-3-90, Unit of Action O&O, 30 June 2003
[11] Strategic Plan for Transforming DOD Training, OUSD P&R Director. Training Readiness and Training Policy, 1 March 2002
[12] J-7 CJCSI 3500.02C, August 2000 Joint Training Master Plan 2002 for the Armed Forces of the United States.

Leaders and Soldiers need live training systems that provide them with immediate, comprehensive, and actionable performance feedback to prepare the Army, normally deployed as an element of a JIM force, to fight and win our nation's wars and succeed in the full range of military endeavors. Gaps between operational environment systems (such as, weapons; Command and Control (C2); Command, Control, Computers, Communications, Intelligence, Surveillance, and Reconnaissance (C4ISR)) and the live training systems continue to widen. The LT2-FTS is the Army's attempt to purge existing live training systems of redundant requirements and to develop a family of systems that absorbs current capabilities centered on a common architecture; and to expand on those capabilities by eliminating gaps between current and future weapons systems and those live Army and Joint training systems available to support them. The LT2-FTS is the genesis for meeting the live training requirements of Current and Future Force of 2015 and beyond and will be fully integrated, interoperable, and support the full spectrum of training needs.

2.2 Specifics. Live training systems must provide the ability to support ***exercise planning and execution***; ***represent weapons and weapons effects***; ***support exercise control***; ***collect***, ***process***, ***distribute***, ***manage***, ***analyze***, ***archive*** exercise data (voice, audio, digital); and ***prepare and present timely feedback(AARs)***. The flow of this data (voice, audio, digital) for immediate feedback and assessment will require systems and components to be both ***interoperable and integrated*** at homestation and when deployed, and able to operate with both classified and unclassified systems. Live training systems must have the ability to stimulate and/or replicate systems that are found on the battlefield. This requires training systems be standardized in data usage and their ***ability to communicate using current C4ISR protocols***.

Training systems designed to support both the Current and Future Force must rely on some ranges that are neither modernized nor capable of providing realistic operational training areas. Ranges must have the ability to ***support modern instrumentation and ever increasing range and lethality*** of weapons systems.

LT2-FTS will look to the Global Information Grid(GIG), Mission Area Initial Capabilities Document(MA ICD), Close Air Support (CAS), Mission Area Initial Capabilities Document and Combat Identification (CID), Mission Area Initial Capabilities Document to ensure compliance.

The Live Fire Futures Analysis, conducted for the Army Research Institute, Report 99-02, indicates advances in training support

capabilities are paramount to overcoming current and emerging deficiencies across all training domains. Army and Joint tasks must be trained and Soldiers and units must become proficient and maintain proficiency in those tasks. This mandates the Army must have the resources and capabilities inherent to its training operations to support ***realistic Force on Force (FOF) and Force on Target (FOT) training*** of Soldiers and systems at the Army and Joint combined arms levels across the full spectrum of military operations. LT2-FTS will support all AUTL and select UJTL tasks by providing live training systems with a ***common core architecture*** that is integrated and interoperable across the LTE. The LT2-FTS will support a level of fidelity not currently available. Increased training fidelity yields improved unit readiness by providing commanders with the ability to better train and assess their Soldiers and units.

3.0 Concept of Operations Summary.

The LT2-FTS will employ a common compliant functional architecture. Under this architecture, LT2-FTS common components will provide the capability to integrate exercises using multiple training range instrumentation, Tactical Engagement Simulation System (TESS), and targetry systems at CTCs, homestations, and while deployed.

Through the LT2-FTS, units will be able to plan, prepare, execute, and assess individual and unit performance in multiple training venues and situations. LT2-FTS supports the integration of training areas, ranges, and/or multi-echelon exercises employing one or more of the instrumented live training ranges, or facilities available at the installation.

The LT2-FTS will link into the Live, Virtual, Constructive Integrating Architecture (LVC-IA) in order to interface with virtual and constructive simulations. This linkage facilitates the synthetic LVC "wrap-around" environment that combatants and non-combatants need to present a complete and realistic operational picture. LVC-IA also provides the sensor simulation/stimulation capabilities necessary for tactical realism and replication of the unit's battlespace. This designed relationship will contribute to the training mission area and complement the integrated joint warfighting force through the JNTC. However, each of the components of LT2-FTS is also capable of stand-alone operations supporting separate, discrete exercises. In a stand-alone mode, they employ only

those common and application-unique components necessary to meet the training objectives.

Common component functional capabilities within LT2-FTS are essentially the same regardless of whether the component is employed within a CTC, homestation, or deployed site. This commonality reduces the learning curve across all training domains. Reducing the education burden, allows units to train earlier with less preparation and equates to more efficient use of training time.

The LT2-FTS is based upon a common training instrumentation architecture (CTIA), which will be compliant with Test and Training Enabling Architecture (TENA). LT2-FTS will interoperate with JNTC through the TENA or through LVC-IA. LT2-FTS will comply with the JLVC-TE JCD and will be interoperable with established standards of the JLVC-TE and the JNTC as they relate to live systems. This capability will facilitate creation of the appropriate joint context required to support the training of UJTL tasks.

4.0 Capability Gap.

4.1 Overview.

Closing the gap between training, leader development, and battlefield performance has always been the critical challenge for any Army. The capability gaps between operational environment systems (such as, weapons; C2, C4ISR) and the live training systems continue to widen. These gaps prevent or significantly degrade the ability to conduct realistic live training needed to prepare the Army, as part of a JIM force, to fight and win our nation's wars. In addition, the gaps impact the ability of commanders to analyze, evaluate, and provide immediate, comprehensive, and actionable training performance feedback for individuals and units. The rapid advancements of technology, the Army/Joint modernization, transformation, aging facilities, and stove-pipe training systems combine to exacerbate the live training systems' shortcomings. The foundation for determining the limitations discussed in this paragraph is a result of reviewing and analyzing volumes of exercise AARs, Army Research Institute (ARI) Studies, technical reports, white papers, Joint and Army CRDs, and various analyses; all of which are referenced in Appendix D-1. Additional analysis can be found at Annex A (Functional Needs Analysis) and Annex D (Functional Area Analysis).

Current live training capabilities lack the abilities of fully integrated, interoperable, networked training systems, thus preventing a realistic simulated operational environment in which there is a shared understanding of the battlespace. Instrumented training systems today are at best "stove-pipe" developed products that have been made to function through various hardware and software "patches" and upgrades. These systems have limited capabilities to provide feedback and analysis. As a consequence, the LTE is saturated with a "hodge-podge" of systems developed for specific tasks. They are not interoperable, integrated, or networked.

As such, the Army's LTE and its domains (institutional, operational, and self-development) cannot function as envisioned in the Strategic Plan for Transforming DOD Training. The DOD plan states: "Develop a robust, networked, live, virtual, and constructive, training and mission rehearsal environment that enables DOD to build unparalleled military capabilities that are knowledge superior, adaptable, lethal, and predicated upon serviceability, interoperability, and Combatant Commander training requirements".

Limitations within the LTE have been divided into five broad categories: 1) Commonality; 2) Integration and Joint Interoperability; 3) Standards and Protocols (Command, Control, Communications, Computers, and Intelligence (C4I)); 4) Ranges and Targetry; and 5) Instrumentation and AARs (Data Management). Limitations of each are highlighted below. Each limitation significantly impacts the Army's ability to meet distributive training demands and deployability needs.

4.1.1 Commonality. Past systems were developed in a stove-pipe fashion and were centered on a proponent or specific local requirements. Programmatically, funding tended to remain stovepiped which prevented a shared development or common approach among systems. Developing training systems in this fashion has resulted in system commonality only through happenstance. Functional Operational Concept (FOC) 12-03 identifies the requirement for commonality in order to achieve seamless linkage of training environments and their participants.

4.1.2 Integration and Joint Interoperability. Among the myriad existing live training systems across the training domains, the capability for integration is extremely limited. A fully integrated live training capability with the appropriate

tool-sets, across training domains, is crucial to enable commanders to conduct assessments and focus on individual and unit proficiency.

In the current live training community, the inability to use common applications and exchange information is a result of the evolution of independent systems and sites to meet specialty training requirements vice fitting into an overarching design. As new training systems are built to meet future capabilities, they must be interoperable with the current training systems. Also, they must meet the migration requirements of the Current and Future Force since these forces and equipment will remain in the force structure for another 15-20 years.

Joint interoperability is an essential central design feature of the new LT2-FTS since our forces will operate in a Joint interdependent environment. Current training systems capabilities, for the most part, do not extend beyond the boundaries of specific service. Compatibility and interoperability with Joint forces is needed to maximize live training play and assessment. For example, integrated and Joint-interoperable training systems must have common probability hit/probability kill ratios (PH/PK), Battlefield Damage Assessments (BDA), and close air support(CAS) linked with the factors Mission, Equipment, Troops, Terrain, and Time (METT-T) across domains. Currently, only limited interoperability among Army, Marine, Navy, and Air Force (Air Warrior) training systems exists because the original systems were not designed to be interoperable or secure. The fact that there is limited interoperability is a result of patchwork to existing systems. True interoperability cannot rely on patched systems.

4.1.3 Standards and Protocols (C4I/Data). The current LTE is limited in its ability to replicate the sources, volume, and fidelity of information available to modernized units. Information delivered to training units should be realistic in nature, i.e., in the form and from the sources that they would receive information on the battlefield. Information infrastructures are limited in their ability to stimulate all Army Battle Command Systems (BCS) available on the battlefield. Limitations in the ability to push and receive data (voice, audio, digital) as one would on the battlefield reduce the commander’s ability to assess both systems and Soldiers proficiency at employing those systems.

4.1.4 Ranges and Targets. Ranges and the targets supporting the training of modernized units should provide a stressful, realistic tactical and operational training

environment. Currently, targets and associated range equipment lack the ability to provide "real-time" sensor to shooter feedback, or linkage of C4ISR systems between Army forces, the targets, and instrumentation. Ranges need the ability to develop and exercise a unit's situational awareness through a common operational picture (COP) developed both vertically or horizontally.

Two-dimensional targets limit engagement angles due to the unpredictability of the shooters' orientation when engagement occurs. This shortfall of predictability also hinders the true assessment of units firing on ranges. Targets and target arrays are not easily reconfigurable or mobile enough to reduce that predictability. Targets do not typically represent friendly units or personnel or non-combatants. Also, live fire training on ranges should be as realistic as possible. Live fire ranges are limited in their ability to provide targets that have shoot-back and self healing capability. Finally, targets and associated range equipment do not always provide immediate feedback to individuals and units. Individuals and units must know when they attain the level of training desired. Just as significant for individuals and commanders is the identification of shortcoming so that remedial training can be programmed to correct deficiencies. Thus an immediate and comprehensive feedback mechanism is required to pin-point the who, what, where, when, and how of the training experience.

Currently, the capabilities of live fire training ranges to interface and integrate players from various locations into common training environments are severely limited. The employment of enhanced and future systems will, most likely, require even larger ranges and more training land, thereby creating substantial land availability and programmatic demands. Through the use of LVC-IA and LT2-FTS, commanders will have options for the conduct of training providing the capability to interface various players while using various LVC venues at disparate locations. This will eliminate the "firing line" mentality and maximize range and land utilization. This will also support the JNTC concept.

4.1.5 Instrumentation and AARs (Data Management). Instrumentation is limited by the interoperability and integration of the supported systems. Multiple tactical engagement simulations (TES) exist at the CTCs and homestations. A deficiency exists in how and what data will be collected and distributed within the Army and with Joint community.

Current instrumentation is limited in its ability to receive and distribute data through networked, integrated, and interoperable systems, since the instrumentation was developed to meet specific site and/or specialty functions. The data collected is not standard among CTCs or among the services. This non-standard approach limits, and in many instances prohibits, the training community's ability to implement a unified distributive training data system.

There are currently no standard After-Action Review (AAR)/feedback requirements associated with instrumentation. The AAR process is an invaluable tool for presenting performance assessments to Soldiers, leaders, and units. The quality of AARs is driven, in no small part, by the amount and type of data available and collected. Therefore, quality instrumentation is essential.

Engagement simulation and instrumentation system solutions must replicate anticipated Ground-to-Ground (GTG), Ground-to-Air (GTA), Air-to-Air/Air-to-Ground (ATA/ATG), Smart Fire and Forget (SFFG), and Future Combat System (FCS) engagements. Instrumented and target engagement systems must not be limited in their ability to provide data for non-lethal and "dud" producing effects, and must not be hindered in providing data due to weather, terrain, vegetation, and/or obscurants.

The current eight (non-integrated) live training systems are not all readily deployable nor do they support future force training data distribution requirements. These live training systems are centered on a "fixed site" mentality, at best, and the distribution of training data is focused within the confines of a particular CTC or homestation maneuver box. Future force requirements mandate that live training systems be distributed to Soldiers and units at numerous locations where they can readily access it on demand (train anywhere, anytime, any place). The intent is not to make fixed facilities (such as CTCs) obsolete, but rather to leverage technology to provide additional training options for units preparing for a CTC rotation, deployed, or at remote locations.

4.2 Attributes of Desired Capabilities. LT2-FTS is a modernized training family of systems that incorporates the entire LTE. LT2-FTS must be built on an open architecture to allow forward and backward interoperability. LT2-FTS is centered upon a single common architecture with standards and protocols which will facilitate interfaces (service specific and Joint) and unit training (exercise planning, system preparation, exercise management, and training performance response). It

will also support Current and Future Force training, to include secure and embedded systems both in classified and unclassified modes. LT2-FTS should also be modular in its approach to provide common components that can be used in a standalone system or networked to provide individual and collective training. LT2-FTS will also be able to interface concurrently with constructive and virtual training exercises and appropriate experimentation through the LVC-IA into a single, multi-echelon, battle focused event. The LT2-FTS must be robust enough to simulate and stimulate the large data flow through Service and Joint C4ISR systems; provide archived data upon which units can draw for training purposes, and be adaptable and deployable. The following provides an outline of the desired LT2-FTS capability attributes referenced in paragraph 4.1:

4.2.1 Commonality. The LT2-FTS products must be Common Training and Instrumentation Architecture (CTIA) compliant. This single common infrastructure provides standards, protocols, and interfaces (service specific and Joint) to support unit training to include exercise planning, system preparation, exercise management and control, and training performance response.

4.2.2 Integration/Joint Interoperability. All components of LT2-FTS must be CTIA, High Level Architecture (HLA), Joint Technical Architecture–Army (JTA-A), Defense Information Infrastructure–Common Operating Environment (DII-COE, Army Training Information Architecture-Migrated (ATIA-M), Testing and Training Enabling Architecture (TENA), and Distributed Interactive Simulation (DIS) compliant. LT2-FTS will interoperate with OneSAF/OneSAF Objective System (OOS) and with other Joint simulations (e.g., Joint Conflict and Tactical Simulation (JCATS), etc). The purpose of the open architecture and HLA compliance is to facilitate interoperability among simulations and promote reuse of simulations and their components.

4.2.3 C4ISR. LT2-FTS must interface with existing C4I components/capabilities in order to permit the rotational units' tactical C4I systems to collect voice and digital training performance data. System communication components must be deployable, tunable, and adjustable. System communication components/configuration must support selective and group bi-directional communications (any time/any configuration) via HLA compliant interfaces.

4.2.4 Ranges and Targetry. Today's ranges and targetry lack integration, networking infrastructure, and

interoperability with the virtual and constructive environments. They are not robust, scalable, flexible, nor mobile. Current installation live training limitations include the inability to:

4.2.4.1 Quickly depict changes in the threat and operational environments.

4.2.4.2 Provide mobile and reconfigurable targets with shoot-back and self-healing capabilities.

4.2.4.3 Portray large numbers of non-combatants and other non-military personnel.

4.2.4.4 Provide sufficient space for live-firing of all Army weapon systems.

4.2.5 Instrumentation and AARs. To effectively collect data, employ the data collected during on-going training, and use it in subsequent training processes, the data must be standardized across the Family of Systems (FOS) and resident in embedded systems when applicable. The data collected must be transportable across systems with no loss of data, acceptable latency, and with no degradation in system performance within the norms of technology employed.

Engagement simulation and instrumentation system solutions are required for GTG, GTA, ATA/ATG, SFFG, and FCS replication. Instrumented and target engagement systems must not be limited in their ability to provide data for non-lethal and "dud" producing effects, and must not be hindered in providing data due to terrain, weather, vegetation, or obscurants. Lastly, LT2-FTS must be robust enough to simulate and/or stimulate the large data flow through service and Joint C4ISR systems; provide archived data upon which units can draw for training purposes; and be adaptable and deployable.

5.0 Threat/Operational Environment.

5.1 Threat to be Countered. LT2-FTS is not designed to counter threats.

5.2 Projected Threat Environment. LT2-FTS must be exposed to the same threats as all other simulations used for training. Threats to LT2-FTS system must include physical threats (i.e., sabotage, espionage, etc.), information collection threats (internal and external), data denial or manipulation threats (introduction of malicious codes or viruses), and reactive threats (identification of system capabilities or dependence could increase the possibilities of countermeasures). Any

connectivity to telecommunications networks in multiple distributed locations and the incorporation of commercial technologies also have inherent threat implications to this system. A discussion of information operations threats can be found in the (U) Information Operations Capstone Threat Assessment, DI-1577-28-04, September 2004, (S//NF).

6.0 Functional Solution Analysis Summary.

The LT2-FTS DOTMLPF requirements determination analyses is derived from the analysis conducted on the current eight live training systems operational requirements documents (ORDs), various working groups, reports and studies, Science and Technology Objectives (STO), and Army Experimentation. The pertinent studies and reports that support the non-materiel solution for LT2-FTS are at Appendix D-1.

6.1 DOTMLPF Analysis. The following DOTMLPF changes were considered as alternatives to LT2-FTS.

6.1.1 Doctrine. Changes in warfighting Tactics, Techniques and Procedures (TTPs) will not affect the ability of training instrumentation systems to become interoperable. Rather, it is the data collected and analyzed from interoperable training instrumentation systems that will affect future TTPs and doctrine.

6.1.2 Organizations.

6.1.2.1 Opposing Forces (OPFOR) organizations are currently in existence to support FOF training at brigade and below. The OPFOR is instrumented and provides valuable challenges and feedback to rotational units which are also instrumented. There are no such forces/organizations that are trained and provide that same challenge and feedback at homestation locations. While smaller OPFOR units could be created to support homestation training, the gaps in live training systems would not be filled. No organizational changes were found that would alleviate current capability gaps in the live training instrumented systems.

6.1.2.2 Currently, the JNTC is the DOD agent designated to broaden and deepen existing joint training through seamlessly linked LVC training worldwide.

6.1.2.3 The Army Training Support Center (ATSC) is the Army's Executive Agent for live training, and is organized to research, integrate, and provide service in support of Army training. In this capacity, ATSC fully supports the JNTC methodology and objectives.

6.1.3 Training. FM 7-0, Training the Force, provides the model of "train-assess-train". Part of the "assess" portion of that model relies on the ability to collect, and analyze data to assess and certify the training status of Soldiers, leaders, and units at battalion and below. Units are currently trained in the operation of various instrumented training systems used for data collection. Individuals are trained to analyze the training data. The absence at homestation of an OPFOR and BLUFOR with instrumentable engagement systems, supported by a data collection and feedback system, significantly impairs the ability to produce a credible live training environment similar to that found a a CTC. No changes in training programs, methods, or manuals could be determined to affect interoperability and commonality gaps in live instrumented systems.

6.1.4 Materiel. Current training systems (National Training Center (NTC)-Instrumentation System (IS), Joint Readiness Training Center (JRTC)-IS, Combat Maneuver Training Center (CMTC)-IS, Homestation Instrumentation Training System (HITS), Integrated Military Operations in Urban Terrain Training System (I-MTS), Digital Multipurpose Range Complex (DMPRC), One-Tactical Engagement Simulation System (OneTESS), and New Generation Army Target Systems (NGATS), were all developed as stove-pipe, stand-alone systems.

In order to seamlessly integrate these stove-piped systems, make them interoperable amongst themselves, and linked to the virtual and constructive environments and the JNTC, each system must be compliant, vertically and horizontally, and use a common architecture approach to ensure interoperability with other applicable architectures (LVC-IA, TENA, ATIA-M, and JTA). This will merge like capabilities and requirements and reduce additional burdens on users, infrastructure, and facilities. The option of maintaining, operating, and resourcing the current stove-piped non-integrated/interoperable systems is neither prudent nor cost effective. The goal of seamlessly linking the LVC environments, to include embedded systems, cannot be achieved via a patchwork approach. Bottom line – Any future enhancement or development of training instrumentation systems must employ a common architectural approach.

6.1.5 Leadership and Education. Identified gaps in current system commonality, deployability, interoperability/ integration, standards and protocols (C4I), targetry, and instrumentation cannot be filled through changes in leadership and education courses.

6.1.6 Personnel. While the addition of personnel alone cannot fill all gaps identified, it is necessary to point out that adequate resourcing of mission support staffs is critical to maintaining required support, assessments, and analysis of training. These personnel are vital to ensuring that valuable and mandated AARs of unit training are conducted at the CTCs within the specified parameters. However, simply adding personnel will not make systems more integrated or interoperable. Filling the training systems gap may actually result in an increase in personnel requirements to operate and sustain the systems. Future embedded training systems may reduce personnel requirements, but in any case, personnel do not affect the ability to fill identified gaps.

6.1.7 Facilities. Facilities and infrastructures will certainly be affected by the integration and interoperability of live training systems. Facilities are operating under different software packages that support different non-common, "stove-pipe" instrumented systems. While a change in facilities and infrastructure alone will not fill all the gaps in instrumented training, they will have a positive impact in the commonality/ standardization of those components used and the ability to collect, distribute, and analyze data, and provides feedback. Standardization of facilities software, components, and capabilities will ensure interoperable "hubs" from which data will flow. Still the individual live training component architecture must be standardized as the basis from which facilities and infrastructure must interchange and exchange data.

Non-materiel changes were considered but found to be inadequate to support the operational requirements to meet the Army's live training requirements for a fully integrated training environment. They do not provide the capability to create the battlefield realism to support live training by simulating the actual weapons system effects. Further, these changes do not provide the LVC interfaces that provide the synthetic wrap-around capabilities and sensor simulation/stimulation necessary for tactical realism to replicate the unit's battlespace. Non-materiel changes also do not provide the means to objectively assess the effects/actions experienced during live training. These solutions do not provide an integrated live training capability to support realistic, performance-oriented training of Soldiers, leaders and units, nor do they provide timely and adequate training feedback focused on the "train as we fight" concept.

6.2 Ideas for Materiel Approaches (MA).

6.2.1 Common and re-usable software.

6.2.1.1 Use the CTIA interchangeable modular concept (plug and play) as the baseline for all software components within the live training arena. Program Executive Office-Simulations Training and Instrumentation (PEO-STRI) is well ahead of others in development and integration of the software modularity for system development. Use of CTIA should reduce developmental costs, speed the rate of implementing required capabilities, and facilitate technology insertion.

6.2.1.2 A second option is to establish an authoritative body that would mandate a "standard" re-usable software and protocols for live component application. This body would use a down-select procedure to determine the best solution-set for achieving required capabilities. However, this option could prove costly, time consuming, and negate the progress already made through CTIA development.

6.2.2 Integration Gap.

6.2.2.1 The first approach is to adopt a Family of Systems (FOS), a holistic approach, consolidating all live training system product lines/components into one integrated, interoperable, and interdependent FOS. This approach provides a complete and accurate view of training that is tied to various training systems. These range from those that capture voice, video, and other digital data, to targetry interaction and feedback, stimulation of the Army Battle Command System (BCS), and Battlefield Effects Simulations (BES). There are interdependencies among all live training systems required to ensure that observer controller/trainers and commanders can provide the best possible assessment of individual and collective training. The overall objective is to produce product lines composed of common components (for example, AAR), and integrated across all the live training systems to meet the functional requirements of LT2-FTS. Functional areas will include but not be limited to: architecture, TESS, instrumentation, targets, AARs, common tool kits, and LVC interfaces of the LT2-FTS. This approach provides the basis for commonality which does not exist today to achieve interoperability. Also within this framework, it would facilitate inserting the "best of breed" in each of the live training system as replacements.

6.2.2.2 The second approach uses an individual system-centric methodology. This option focuses on the modification of existing system product lines/components to permit each to interface and share information with other live

training systems having similar requirements and product lines/components. Under this approach, it would be necessary to modify and enhance each unique system with an integrated architecture that would be responsive and interoperable across the training environments. It would also be necessary to designate an integrator to identify those components and existing systems for integration, and then develop priorities and timelines while allowing for rapid technology insertions. The systems of today were based on unique requirements and were developed and implemented separately vice implementing a FOS approach with integrated product lines/components.

Either approach requires the implementation of standards and the use of a common training architecture.

6.2.3 Interoperability Gap. Interoperability for training systems goes far beyond the Army's LTE and includes the LVC, JNTC, and JIM environments. Within the live environment, two approaches were considered.

6.2.3.1 Leverage the CTIA compliant live training components and link their capabilities to the virtual and constructive environments through the LVC-IA. The LVC-IA will serve as the authoritative architecture to link the LVC environments with the JNTC.

6.2.3.2 Research and develop universal translators and gateways which will provide interoperability by accessing and converting data among all architectures and nodes.

6.2.4 Communications/Data Standards and Protocols.

6.2.4.1 Consider use of CTIA as the evolving standard for live training architecture and leverage existing standards and protocols (C4I) components for integration of voice, audio, and digital training data. This provides the best immediate solution for live training as CTIA matures in its applications.

6.2.4.2 A second option is to specify and limit use to a "suite" of common systems and protocols, three to five, which are interoperable. This prevents an "all or nothing" situation and allows for additional options in the event of a system-wide glitch/failure.

Either option must be HLA and JTA compliant to facilitate interoperability and integration.

6.2.5 Stimulate and Interact with BCS. Research and develop a universal tactical node translator to support simulation/stimulation for C4I Interoperability (SIMCI), TRADOC

Program Integration Office (TPIO), BCS, FCS/UA, Synthetic Environment (SE) Core, Army Constructive Training Federation (ACTF), CTIA, One Semi-Automated Forces (OneSAF), and TENA. Current capabilities stop at the Army tactical systems level. Since the training audience will most often see reality through embedded C4ISR, increased collaboration is essential between the various materiel developers and with the live training development community.

6.2.6 Ranges and Targets.

6.2.6.1 Expand the target inventory to include additional three dimensional targets, and associated attributes and characteristics to provide more non-combatant and friendly elements to more accurately replicate the operational environment of the battlefield. Develop targets that are "self-healing" to reduce replacement costs. Ensure that new target systems are reconfigurable and deployable to better portray various scenarios. Targets must possess instrumentation components, linked with C4ISR systems, to provide real time sensor to shooter feedback.

6.2.6.2 Design ranges that make maximum use of available training land and are capable of supporting the increased range and destructive capability of advanced weapons systems. Combining test and training ranges, where appropriate, and linking disparate training sites will maximize the use of existing capabilities.

6.2.7 Instrumentation and AARs.

6.2.7.1 Establish authoritative source(s) for standard data definitions, leverage and influence commercial sources, techniques and standards.

6.2.7.2 Collaboratively design and build a data repository with ATIA-M and JNTC.

6.2.7.3 Develop standard style guides/templates. This will give a common look and feel to role players, technical control, exercise control, and exercise planning, etc., across all three domains. Further, it will save development time and resources for modules. Standard style guides/templates will ensure Joint interoperability and provide common PH/PK and BDA across the domains.

6.2.7.4 Ensure common components have ability to send/receive data via host system that are HLA/JTA compliant.

6.2.7.5 Identify baseline components and configurations required for specific training events and/or unit level play.

6.2.7.6 Design components and software with modular and "plug and play" capabilities.

6.2.7.7 Develop open solutions and techniques to bridge gaps that will exist in required capabilities. Design and build a data repository (collaborative effort with ATIA-M and JNTC).

6.2.8 Although no other service has an integrated live training family of systems (FoS) that addresses the identified capability gaps, future development of LT2-FTS will look to other services and agencies, foreign armies, and industry to identity material approaches for developing components of LT2-FTS.

6.3 Analysis of Materiel Approaches (AMA). The DOTMLPF analysis documented as part of the Functional Solution Analysis (FSA) summarized in paragraph 6.1 indicates that integrated materiel solutions are required to eliminate the identified gaps in live training systems. A subjective analysis of alternative materiel approaches was conducted. The results are summarized below:

The CTIA is best suited as the baseline architecture for implementation of the LT2 "Family of Systems" approach. CTIA-compliant common and reusable components (software, hardware and data) would be used to develop and implement Objective Instrumentation Systems (OIS) at the CTCs and homestations. The common components include: standard interfaces to virtual and constructive simulation systems, tactical C4ISR systems, the ATIA-M, and targetry systems that must be interoperable with LT2-FTS product lines, or vice versa. The ongoing work with CTIA within the LTE makes it the logical choice as the basis of LT2-FTS.

Modification of existing systems was not judged to be an acceptable cost efficient or effective solution. It was accepted that existing systems could be upgraded with CTIA compliant software. However, this approach remains fragmented and resource intensive, in the long run, because of the extensive modifications required for each stovepipe system to attain and retain interoperability across the LTE. The FOS approach of using common and reusable components would provide the synergy needed as we transform Army training.

The LT2-FTS materiel approach maximizes the effectiveness and cost efficiency derived from the inherent commonality,

integration, and interoperability of the functional, operational, and product lines that make up the live portion of Army Training. The LT2-FTS provide instrumentation systems, TESS equipment, range instrumentation, targetry, and the means to plan, prepare, execute, and evaluate FOF and FOT training, while providing interfaces to virtual and constructive training systems, and the Army's C4ISR systems. This provides standards, flexibility, and consistency for systems migration and interface with Joint training systems.

7.0 Final Material Recommendations.

7.1 Summary. The recommended materiel solution to close the capability gaps discussed in paragraph 4 is to consolidate live training systems into a "Family of Systems" using CTIA as the base architecture from which all live training system components will evolve. This option is judged to be the most cost effective and efficient as CTIA matures and is integrated (spiraled) into the Live Training OIS currently under development for the Combat Training Centers. Through interoperability with LVC-IA, CTIA provides the basis for virtual and constructive simulation system interfaces that provide the synthetic wrap-around capability. The overall recommendation stresses developing common components, modules, tools, and capabilities that can be reused throughout the live Army and Joint training environment. This approach will also provide the means to capitalize on advances in technology. Material solutions must comply with all U.S., foreign and international environmental quality, environment, safety, and occupational health (ESOH) laws and regulations. The concepts of Human Systems Integration (HSI) will be applied in designing, developing, and integrating any materiel solution selected to optimize total system performance, minimize total ownership cost, and ensure the system is built to accommodate the characteristics of the user population that will operate, maintain, and support the system. A summary of recommendations for each gap is outlined below:

7.1.1 Commonality. Establish an authoritative body to establish and mandate "Commonality." Use CTIA and PEO-STRI successes with CTIA as the baseline for implementing commonality within LT2-FTS. Use the CTIA as the baseline for the development of components within the live training arena that ensures integration, interoperability, and reuse. PEO-STRI is well on the way in the development and integration of LT2-FTS components based on CTIA. Continued use of CTIA should reduce

developmental costs and speed the rate in which we meet the capabilities required while supporting technology insertion.

7.1.2 Integration/Joint Interoperability. The first approach is to consolidate all live training systems/components into one interdependent FOS. The FOS approach provides a complete and accurate overview of training live training systems ranging from those that capture voice, video, and other digital data, to targetry interaction and feedback, to stimulation of the BCS and BES. This development approach using a live training integration architecture, compatible with existing architectures, and composed of common reusable components ensures interoperability across all training domains within each training environment. The more system-centric approach would require modifying existing systems to incorporate a common integrating architecture and would require the development of universal tactical node translators. It would not assure interoperability or be attained without significant expenditure of resources. Use the LT2-FTS, CTIA based, approach to develop and sustain live training systems that are interoperable through LVC-IA to the V-C environments.

7.1.3 C4ISR/Data Standards and Protocols. Consider use of CTIA as the emerging standard live training architecture and leverage existing C4ISR components for integration of voice, audio, and digital training data. This provides the best immediate solution for live training as CTIA is mature in its applications. Use HLA compliant interfaces to support system communication components.

7.1.4 Ranges and Targets. Invest in a new generation of Army targets that are three dimensional, provide for multi-spectral capability, incorporate additional target types (non-combatants, friendly forces, etc.), and are linked through C4 systems to provide real time sensor to shooter capability. Charter a team to review the ability to combine training and test ranges in an effort to research and employ deployable capability and maximize land usage.

7.1.5 Instrumentation and AARs. Establish authoritative source(s) for standard data definitions, and leverage/influence commercial sources, techniques, and standards.

7.1.5.1 Design and build a data repository (collaborative effort with ATIA-M and JNTC).

7.1.5.2 Develop standard style guides. This will give a common look and feel to role players, technical/exercise control, and exercise planning, etc., across all three domains.

7.1.5.3 Research and develop a universal tactical node translator to support stimulation (SIMCI, TPIO ABCS, FCS/UA, SE Core, ACTF, CTIA, OneSAF, TENA).

7.1.5.4 Ensure common components have ability to send and receive data via host system that are HLA/JTA compliant.

7.1.5.5 Design components and software to support modular and "plug and play" capabilities. These designs must capitalize on and augment CTC capabilities.

7.2 Analysis of Alternatives (AoA). The AoA boundary should include alternatives that can be implemented by 2007, and that meet the minimum capabilities described in paragraph 4.1.

7.3 Implications and Constraints. The non-materiel/DOTMLPF implications and constraints associated with the recommended materiel solution to address LTE capability gaps are discussed below:

7.3.1 Doctrine. No change in warfighting doctrine is anticipated.

7.3.2 Organization. Organizations already exist to guide the direction and linkage of the LVC environments. However, each service and agency must identify their path for linkage into existing architectures to achieve an LVC wrap-around in support of Joint and Army forces.

7.3.3 Training. Minimal training impacts are envisioned at the user level in operation and maintenance of systems. However, no changes in training programs, methods, or manuals could be determined to affect interoperability and commonality gaps in live instrumented training systems.

7.3.4 Leadership. Leadership and education changes are not anticipated.

7.3.5 Personnel. Personnel structures established in support of current live training are not expected to change. However, requirements for additional personnel may increase as live fire training systems become more deployable. There is the possibility that government and/or contract personnel will be required to provide set-up, operation, and provide maintenance of deployed instrumented training system.

7.3.6 Facilities. Facilities and infrastructures will be affected through the upgrade of integrated standardized software, hardware, and the potential for more robust communications capabilities. However, changes in current facility structures will not affect or solve capability gaps identified.

Appendix A
Integrated Architecture Products

Operational View-1 (OV-1)

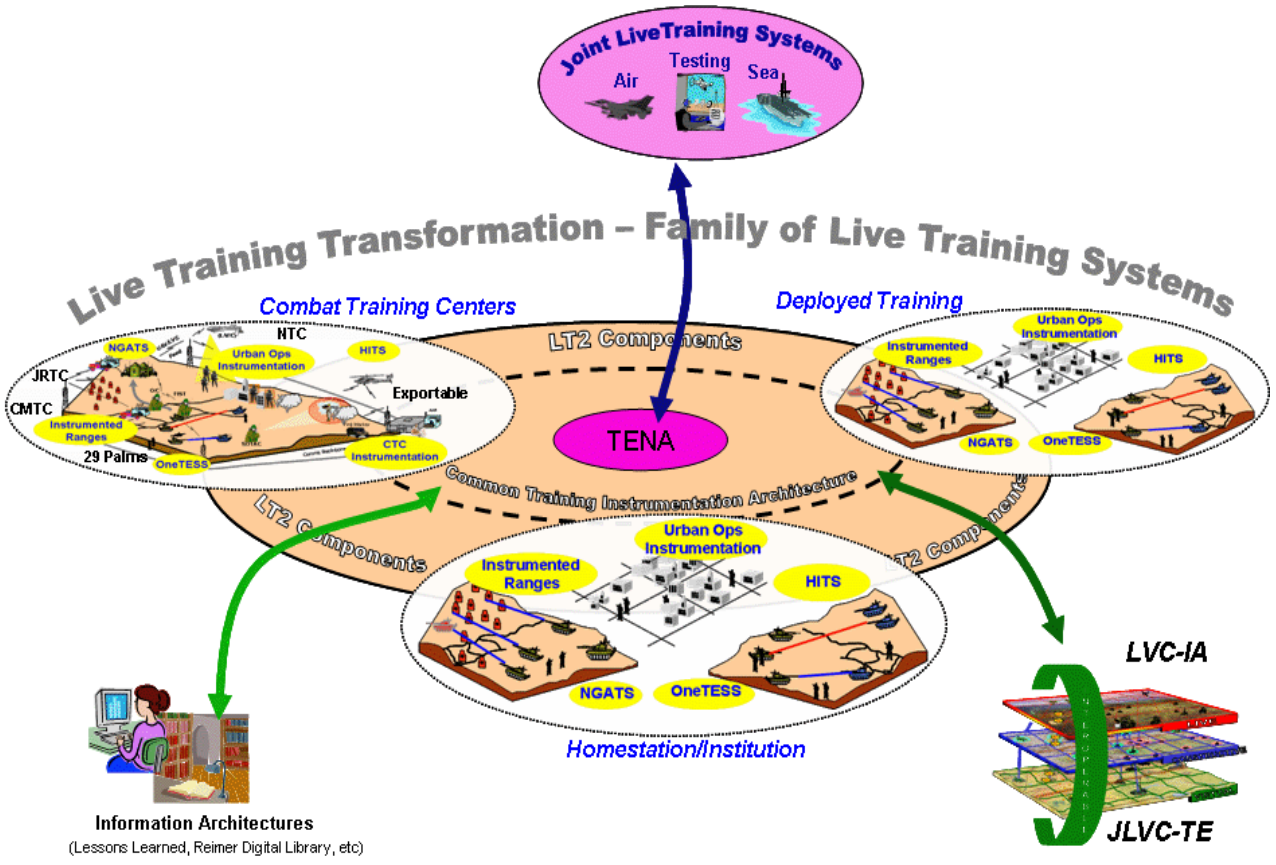

FIGURE 2. OPERATIONAL VIEW (OV-1) DIAGRAM

The purpose of the OV diagram depicts the key relationships that present top-level interoperability requirements with other current and future known systems. The OV diagram must support the Operational and Organizational (O&O) description and NET Ready Key Performance Parameter (NR KPP). The above diagram depicts the operational view for the LT2-FTS concept. Specifically, this view depicts CTIA as the architecture that will serve as the foundation for standardization and interoperability between the functional and common components that make up the various live training programs. CTIA, as the LT2-FTS core component

architecture is capable of linking to and interoperating with those architectures on the upper outer rim of diagram.

Appendix B
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Guide for Development of Army Initial Capability Documents (ICD), 22 October 2003.

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Combat Identification, Mission Area Initial Capabilities Document (CID MA ICD) 19 March 2001.

Global Information Grid, Mission Area Initial Capabilities Document (GIG MA ICD), 22 November 2002.

White Paper, Future Combat System Embedded Training, Version 7, 5 July 2002.

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National Training Center Instrumentation System (NTC-IS), approved 1996.

Combat Maneuver Training Center Instrumentation System (CMTC-IS), approved 1994.

Joint Readiness Training Center Instrumentation System (JRTC-IS), approved 1995.

Homestation Instrumentation Training System (HITS), awaiting approval.

One-Tactical Engagement Simulation System (OneTESS), awaiting approval.

Integrated MOUT Training System (IMTS), awaiting approval.

Digital Multi-Purpose Range Complex (DMPRC), approved 1999.

New Generation Army Target System (NGATS), approved 1996.

Multiple Integrated Laser Engagement System (MILES) 2000, approved 1996.

Future Combat Systems Operational Requirements Document, 30 June 2003.

Global Information Grid (GIG) Mission Area Initial Capabilities Document (MA ICD), JROCM 202-02, 22 November 2002

Appendix C

Abbreviations and Acronym List

ACRONYM	**DEFINITION**
A3RM	Advanced After Action Report Media
AAR	After-Action Review
ABCS	Army Battle Command System
ABCSI	Army Battle Command System Integration
AC	Active Component
ACAT	Acquisition Category
ACTF	Army Constructive Training Federation
ADA	Air Defense Artillery
AGES II	Air to Ground Engagement System II
AMA	Analysis of Materiel Approaches
AMP	Army Modernization Plan
AoA	Analysis of Alternatives
AR	Army Regulation
ARFOR	Army Forces
ARI	Army Research Institute
ARL	Army Research Laboratory
ARNG	Army National Guard
ART	Army Tactical Task
ASB	Army Science Board
ASTMP	Army Science and Technology Master Plan
ATA	Air to Air
ATD	Advanced Technology Demonstration
ATES	Advanced Tactical Engagement Simulation
ATESC	Advanced Tactical Engagement Simulation Concepts
ATG	Air to Ground
ATIA-M	Army Training Information Architecture-Migrated
ATM	Army Tactical Mission
ATMD	Army Training Modernization Directorate
ATSC	Army Training Support Center
AUTL	Army Universal Task List
AWE	Area Weapons Effects
BCTP	Battle Command Training Program
BCS	Battle Command Systems
BDA	Battle Damage Assessment
BDE	Brigade
BES	Battlefield Effects System

ACRONYM	**DEFINITION**
BFA	Battlefield Functional Area
BOS	Battlefield Operating System
C2	Command and Control
C4I	Command, Control, Communications, Computers, and Intelligence
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
CALFEX	Combined Arms Live Fire Exercise
CAS MA ICD	Close Air Support (CAS), Mission Area Initial Capabilities Document
CATS	Combined Arms Training Strategy
CATT	Combined Arms Tactical Trainer
CCIR	Commander's Critical Information Requirements
CID MA ICD	Combat Identification, Mission Area Initial Capabilities Document
CMTC	Combat Maneuver Training Center
COCOM	Combatant Command (Command Authority)
COE	Common Operating Environment
COE	Contemporary Operational Environment
CONPLAN	Operation Plan in Concept Format
COP	Contemporary Operational Picture
CRD	Capstone Requirements Document
CRIDT	Cognitive Requirements for Information Operations Training
CTC	Combat Training Centers
CTC-OIS	Combat Training Center-Objective Instrumentation System
CTIA	Common Training Instrumentation Architecture
DCSINT	Deputy Chief of Staff for Intelligence
DII-COE	Defense Information Infrastructure-Common Operating Environment
DIS	Distributed Interactive Simulation
DMPRC	Digital Multi-purpose Range Complex
DMPRC-OIS	Digital Multi-purpose Range Complex – Objective Instrumentation System
DOD	Department of Defense
DODAF	Department of Defense Architectural Framework
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities
EET	Enhanced Embedded Training
EMI	Electro-Magnetic Interference

ACRONYM	**DEFINITION**
ES	Embedded Simulation
ESOH	Environment, Safety, and Occupational Health
ET	Embedded Training
EW	Electronic Warfare
FAA	Functional Area Assessment
FBCB2	Force XXI Battle Command-Brigade and Below
FCS	Future Combat System
FNA	Functional Needs Analysis
FOC	Future Operational Capability
FOC	Force Operating Capabilities
FOC	Force Operational Concept
FOF	Force on Force
FOS	Family of Systems
FOT	Force on Target
FSA	Functional Solution Analysis
GIG	Global Information Grid
GIG MA ICD	Global Information Grid Mission Area Initial Capabilities Document
GTA	Ground to Air
GTG	Ground to Ground
GUI	Graphic User Interface
HITS	Homestation Instrumentation Training System
HLA	High Level Architecture
HLS	Home Land Security
HS	Homestation
HSI	Human Systems Integration
IAW	In Accordance With
ICD	Initial Capabilities Document
IEW	Intelligence and Electronic Warfare
I-MTS	Integrated Military Operations on Urban Terrain Training System
INVEST	Inter-Vehicle Embedded Simulation Technology
IS	Instrumentation System
ISR	Intelligence surveillance, and Reconnaissance
IT	Information Technology
JCATS	Joint Conflict and Tactical Simulation
JCF AWE	Joint Contingency Force Army Warfighting Experiment
JFC	Joint Functional Concept
JFCOM	Joint Forces Command
JIM	Joint Interagency Multinational or
JIIM	Joint Interagency Intergovernmental Multinational

ACRONYM	**DEFINITION**
JMETL	Joint Mission Essential Task List
JMETS	Joint Mission Essential Tasks
JNTC	Joint National Training Capability
JOC	Joint Operating Concepts
JOE	Joint Operational Environment
JRTC	Joint Readiness Training Center
JTA-A	Joint Technical Architecture – Army
KPP	Key Performance Parameters
LF	Live Fire
LFF	Live Fire Futures
LT2-FTS	Live Training Transformation-Family of Training Systems
LT2	Live Training Transformation
LTE	Live Training Environment
LVC	Live Virtual Constructive
LVC-IA	Live Virtual Constructive Integrating Architecture
MCO	Major Combat Operations
MCTC	Maneuver Combat Training Centers
MD	Materiel Developer
MILES	Multiple Integrated Laser Engagement System
MOUT	Military Operations on Urbanized Terrain
MOUT-IS	Military Operations on Urbanized Terrain – Instrumentation System
NBC	Nuclear, Biological, Chemical
NET	New Equipment Training
NGATS	New Generation of Army Targets
NLOS	Non-Line-Of-Sight
NTC	National Training Center
NTC-OIS	National Training Center – Objective Instrumentation System
O&O	Operational and Organizational
O/T	Observer/Trainer
OC/T	Observer Controller/Trainer
OICW	Objective Individual Combat Weapon
OIS	Objective Instrumentation System
OneSAF	One Semi Automated Forces
OneTESS	One-Tactical Engagement Simulation System
OOS	OneSAF Objective System
OP	Operational
OPLAN	Operations Plan

ACRONYM	**DEFINITION**
OPFOR	Opposing Force
ORD	Operational Requirements Document
OV	Operational View
PEO-STRI	Program Executive Office-Simulation, Training, and Instrumentation
PH	Probability Hit
PK	Probability Kill
PM TRADE	Program Manager, Training Devices
RSTA	Reconnaissance, Surveillance, and Target Acquisition
SE	Synthetic Environment
SFFG	Smart Fire and Forget
SIMCI	Simulation to C4I Interoperability
SN	Strategic National
SO	Stability Operations
SRP	Sustainable Range Program
ST	Strategic Theater
STE	Synthetic Training Environment
STO	Science and Technology Objectives
TAAF	Training Analysis and Feedback
TADSS	Training Aids, Devices, Simulators, and Simulations
TAF	Training Analysis and Feedback
TBD	To Be Determined
TD	Training Developer
TEMO	Training Exercises and Military Operations
TENA	Test and Training Enabling Architecture
TES	Tactical Engagement Simulation
TESS	Tactical Engagement Simulation System
THP	Take-Home Package
TM-UWB	Time Modulated-Ultra-Wideband
TOC	Tactical Operations Center
TPIO	TRADOC Program Integration Office
TRADOC	Training and Doctrine Command
TSI	Training Support Infrastructure
TTP	Tactics, Techniques, and Procedures (TTPs)
UA	Units of Action
UE	Units of Employment
UJTL	Universal Joint Task List
USACAC	U.S. Army Combined Arms Center
USACCA	U.S. Army Concepts Analysis Agency

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Appendix D-1

Pertinent Studies/Analysis Summaries

The pertinent studies and reports and Science and Technology Objectives (STOs) that support the non-materiel solution are listed below:

a. Live Training Environment Architecture, ATSC, 13 September 1996. This report defines the family of training support products managed by the ATSC that are required to support Force XXI and the Army After Next. This family of training support products is defined in two ways. The first defines a product line by assigning names and definitions to family members. The second defines requirements for these products, expressed in terms relevant to the Army's training process for conducting battle-focused training.

b. Training Analysis and Feedback Aids (TAAF Aids) Study for Live Training Support, ATSC, 30 September 1999. This report identifies the impact of force modernization on future exercise control and training feedback functions at the battalion task force level and below during live training. The TAAF Aids Study identifies manual control and feedback tasks imposed by force modernization initiatives, after-action review (AAR) preparation, unit take-home package (THP) construction, and observer controller/trainer (OC/T) coaching/mentoring.

c. Advanced Tactical Engagement Simulation Concepts (ATESC), ATSC, 29 January 1999. This study develops and prioritizes concepts for a TES system that integrates the simulation of direct fire, indirect fire, and non-lethal weapons and reduces trainer control and data collection duties. The study also addresses stimulation and feedback needs of target acquisition systems.

d. Cognitive Requirements for Information Operations Training (CRIOT), ATSC, 29 January 1999. This study describes the types of digital system displays trainers require to support control and feedback requirements for the digitized battalion task force.

e. Advanced After Action Report Media (A3RM), ATSC, 29 January 1999. This study provides concepts to promote more efficient and effective post-event collective learning,

reduce trainer workload, focus AAR preparations and overcome presentation management difficulties.

f. Live Training, Data Collection, Analysis, Simulation/Stimulation, and Feedback Requirements to Support Joint Contingency Force Army Warfighting Experiment (JCF AWE), ATSC, 30 September 1999. The purpose of this report was to describe tactical and training data collection, analysis, simulation/stimulation, and feedback requirements (primarily training instrumentation and tactical engagement simulation) for the brigade and below portion of the live component for the JCF AWE.

g. Live Training Sustainment, Integration, and Synchronization Program Final Report, ATSC, 4 May 1999. Report represents the culmination of a two-year study of the impact of technological advances on live training. The training of brigade and smaller sized units is the focus of this study. This analysis centers on the impact of technology on four live training product lines (Targets, TESS, instrumentation systems (ISs), and Opposing Forces (OPFORs) and the ability of the live training support infrastructure to provide realistic training well into the 21st Century.

h. Live Fire Futures (LFF) Report, U.S. Army Research Institute, 20 February 2000. This study analyzes the impact of force modernization and asymmetric warfare on future LF training, recommends a new LF training strategy, and describes a concept for future LF ranges. The Army's force modernization goals include improving the range, precision, and effects of direct and indirect fires. Such enhanced capabilities will significantly influence requirements for support of LF training. The employment of smart weapons, non-line-of-sight weapons, new target acquisition systems, and digital command, control, and communications systems will characterize future combat and should be included in future training. The other major force for change in live fire (LF) training is the non-linear nature of future combat. Prominent in the Army's challenges of the 21st Century will be a wide range of possible operational environments in terms of strategic goals, the political-military situation, and the nature of the enemy, civilian population considerations, and the characteristics of the battleground. These too must be addressed in the design of training support.

i. Training Support Assessment for the Future Combat System (FCS), ATSC, 14 January 2001. This paper provides a conceptual training foundation for the Future Combat Systems (FCS) Training Support Program. In this paper, the FCS training concept is described by outlining NET requirements and "battle-focused" (i.e., combat) training requirements. NET training is primarily classified in two main subjects: operator and maintenance training. The combat training requirements fall into eight main subjects. These "battle focused" training subjects are inter-dependent and complementary; each providing a discrete piece of the FCS training solution.

j. Enhanced Embedded Training (EET), ATSC, 19 July 2000. This paper introduces the concept of "Enhanced Embedded Training" and then weighs its benefits and risks. The EET concept goes beyond operator/maintenance New Equipment Training (NET) and, also, includes fully embedded "battle-focused" training capabilities. This is the feature that distinguishes EET from other embedded training concepts. It is a departure from established materiel acquisition paradigms, in that it would increase the role of the training developer (TD) in the early stages of the materiel acquisition process and levy increased responsibility to the materiel developer (MD) for obtaining performance aids associated with combat-related jobs. The EET concept will require training developers to describe their needs earlier in the materiel acquisition process and in greater detail than ever before. It identifies the complex management and leadership issues associated with obtaining the EET capability. The EET concept is further described by outlining generic requirements for embedded operator/maintenance NET, which is the typical, foundation ET concept. Expanding the typical ET concept, the paper also describes eight notional projects to identify the scope of "battle-focused" training capabilities and needs. These projects parse the total technical effort into identifiable program thrusts. These eight projects are inter-dependent and complementary; each providing a solution for a discrete piece of the EET concept.

k. Combat Training Centers - Objective Instrumentation System (CTC-OIS), University of Texas Austin, Applied Research Laboratories, 31 January 2001. The purpose of the study was to conduct analysis, research, and evaluations pertaining to a new Objective Instrumentation System (OIS) for the three Army Combat Training Centers (CTCs):

- The National Training Center (NTC) at Fort Irwin, California.
- The Joint Readiness Training Center (JRTC) at Fort Polk, Louisiana.
- The Combat Maneuver Training Center (CMTC) at Hoenfels, Germany.

This Functional Specification (FS) establishes the instrumentation system functional requirements that are common to the three CTCs, and serves as a step in the process of developing a technically defining specification for the OIS. In addition, as the threat capabilities change, or as the Army encounters new or different conditions in an operational environment, the CTC-OIS capabilities are reviewed and updated.

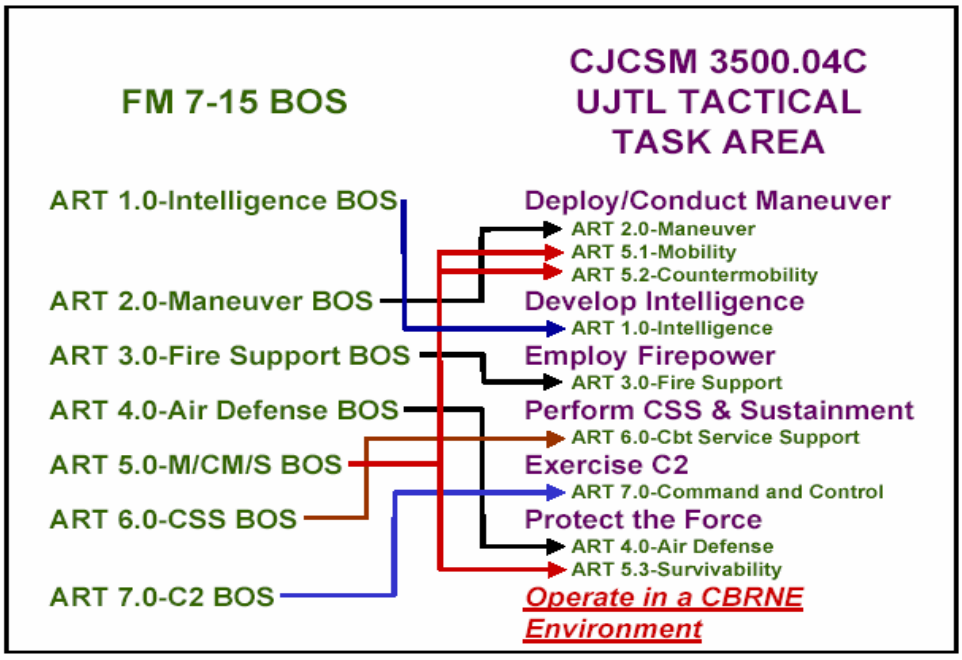
l. Critical Technologies and Capabilities for Future Combat Systems (FCS) in Urban Combat and Stabilization Operations, Army Science Board (ASB), July 2004. The study was conducted by over 50 ASB members, consultants, and government advisors between November 2003 and July 2004. Recommendations listed in the study included the need to: develop personnel databases and training technologies accessible anytime, anywhere in the urban theater; develop and exploit air presence for battle command; persistent reconnaissance, surveillance, and target acquisition (RSTA); maneuver, fire effects, and sustainment; and conduct integrated systems experiments to facilitate Doctrine, Organization, Training, Materiel, Leadership, Personnel and Facilities (DOTMLPF) integration. The study proposed potentially replicating a large scale urban setting (CTC-like) and full utilization and integration of modeling and simulations.

m. Inter-Vehicle Embedded Simulation Technology (INVEST) STO; Simulations, Training, and Instrumentation Command (PEO STRI). The INVEST STO program objective is to develop and demonstrate technology that is needed to fully embed a simulation and training system in ground combat vehicles for the Army 2010 and beyond. INVEST STO is evolving an architecture suitable for implementation of embedded simulation (ES) in current and future vehicles. PEO STRI intends to transition these capabilities into the proposed ET Advanced Technology Demonstration (ATD).

n. Advanced Tactical Engagement Simulation (A-TES) STO, PEO STRI. The A-TES STO objective is to research and develop affordable TES technology solutions for advanced non-line-of-sight (NLOS) and top attack weapons systems. The Objective Individual Combat Weapon (OICW) and other indirect fire weapons impose new requirements beyond the simulation capability of current TES systems. The project is developing prototype simulation infrastructure, architecture, tools, and processes; demonstrating prototype hardware in a laboratory environment; and developing a technology roadmap for Time Modulated Ultra-Wideband (TM-UWB). PEO STRI intends to transition these capabilities into the proposed ET Advanced Technology Demonstration (ATD).

Appendix D-2

AUTL – UJTL Cross Reference



Appendix D-3

Required Capabilities Extract & Crosswalk

Required Capabilities Extract - Section 2

- Exercise Planning & Execution
- Represent Weapons & Weapons Effects
- Support Exercise Control
- Collect, Process, Distribute, Manage, Analyze, & Archive Exercise Data (Voice, Audio, & Digital)
- Prepare and Present Timely Feedback - After Action Reviews (AARs)
- Interoperable & Integrated Systems & Components
- Communicate Using Current C4ISR Protocols
- Support Modern Instrumentation & Increasing Range & Lethality of Weapon Systems
- Support Live Training from Homestation & & Deployed Locations

Establish & Sustain Live Training Environment that Closely Replicates the Full Range of Military Operational Environment

Capability Gaps Section 4	Functional Analysis Summary Section 6	Final Materiel Recommendations Section 7
4.1.1 Commonality	6.2.1 Common & Re-usable Components	7.1.1 Commonality
4.1.2 Integration & Joint Interoperability	6.2.2 Integration gap 6.2.2.1 Interoperability	7.1.2 Integration & Joint Interoperability
4.1.3 Standards & Protocols (C4I/Data)	6.2.3 Communications Standards/Protocols	7.1.3 C4ISR/Data Standards & Protocols
4.1.4 Ranges & Targetry	6.2.4 Ranges & Targetry	7.1.4 Ranges & Targetry
4.1.5 Instrumentation & AARs	6.2.5 Instrumentation & AARs	7.1.5 Instrumentation & AARs